

# Radioactive Waste Disposal

Preparation Time:	Easy-to-do	Moderate	Extensive
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<b>Grade:</b>	9 – 12
<b>Focus:</b>	Exploring the need for safe radioactive waste disposal
<b>Subject:</b>	Science, Social Studies
<b>Materials:</b>	“Nuclear Energy: Benefits and Problems” activity sheet included with this lesson
<b>Teaching Time:</b>	One class period. This lesson should be used in conjunction with the lesson “Nuclear Power in Our State.”
<b>Vocabulary:</b>	Radioactive waste, deep geologic repository, transuranic waste, high-level radioactive waste, near-surface radioactive waste disposal

and nuclear weapons also is radioactive waste. Unless they are solidified or absorbed, these take the form of a liquid or sludge.

In the United States, radioactive materials are divided into two groups for purposes of permanent disposal. One group consists of wastes that can be disposed of in the upper 100 feet of the earth's surface in a disposal facility like the one in Barnwell County, South Carolina. This is called near-surface disposal. The other group consists of wastes that require a higher degree of isolation in a **deep geologic repository**.

The only deep geologic repository currently operating is the federal Waste Isolation Pilot Project (WIPP) located near Carlsbad, New Mexico. The WIPP site accepts long-lived radioactive waste, known as **transuranic waste**, from the Savannah River Site in South Carolina and other U.S. Department of Energy (U.S. DOE) facilities.

## Learning Objectives

In this lesson students will:

- explore the need for safe disposal of radioactive waste;
- see why South Carolina plays such a vital role in radioactive waste disposal; and
- learn what South Carolina's responsibilities will be in the future.

## Background

**Radioactive waste** comes in many forms. Familiar objects that we encounter on a daily basis can be considered radioactive waste if they become radioactively contaminated. These include uniforms, gloves, construction materials and tools. Some radioactive waste is less familiar. Filter material used for capturing radioactive elements in the cooling water of nuclear power plants is a common form of radioactive waste. The processed residue from the manufacture of nuclear materials

Another deep geologic repository under development, the Yucca Mountain site in southeast Nevada, will accept spent nuclear fuel from commercial power plants. The Yucca Mountain site also will accept **high-level radioactive waste** that is now in storage at U.S. DOE facilities. Included in this will be plutonium wastes and other high-level waste from the Savannah River Site and other federal sites. Until the Yucca Mountain site begins accepting waste, most spent fuel from nuclear power plants will continue to be stored at the 110 nuclear reactor facilities across the nation in water-filled fuel pools.

The federal government requires that **near-surface radioactive waste disposal** facilities be owned by the federal government or by state governments. This is because these facilities will require monitoring, custodial care and restricted access long into the future. The near-

surface disposal facility in Barnwell County is owned by the State Budget and Control Board and is operated under a lease agreement by a private company. There are currently only two other such disposal facilities for commercially-generated radioactive waste in operation in the United States. One of these is located in eastern Washington State and the other is west of Salt Lake City, Utah.

The facility in Barnwell County was opened in 1971 and has disposed of about 27 million cubic feet of waste over an area of 100 acres. Waste is placed in large, specially-built trenches. Each trench has a gently sloped floor to prevent accumulation of water during the period the trench is open. A layer of gravel separates the waste packages from any ground water that may intrude during waste emplacement operations. Once filled, each trench is capped with a sandy clay material in order to channel surface water away from the trench area. Upon site closure, a permanent multi-layer cap consisting of both natural and synthetic materials will be placed over the entire site as further protection against the intrusion of surface water into the trenches.

As with the other similar facilities, there are strict regulatory limits on the form of the wastes that can be accepted. Wastes cannot include free-standing or unabsorbed liquids. They cannot include chemically hazardous materials. Waste packages must be generally free of air pockets that could cause the trench caps to sink.

Federal and state regulations require an environmental monitoring program to detect any radioactivity outside the trenches. The monitoring program must continue for at least 100 years after the site is closed.

In late 1999, S.C. Governor Jim Hodges created the S.C. Nuclear Waste Task Force that recommended a portion of the remaining 3 million cubic feet of disposal capacity at the Barnwell disposal facility be saved for use by nuclear power plants and other industries located within the state. These seven nuclear plants will require a large amount of disposal space in future decades. The task force was concerned that if South Carolina did not take action, the Barnwell site would be filled with waste from other states long before our own industries needed it.

Following a recommendation by the task force, the S.C. General Assembly in 2000 joined a three-state alliance with Connecticut and New Jersey called the Atlantic Interstate Low-Level Radioactive Waste Compact. Because the Atlantic Compact had been authorized by the U.S. Congress to limit access to its regional disposal facility to the member states only, this provided the legal authority the state needed to keep out waste from other regions. The 2000 law also phased out acceptance of radioactive waste from across the nation. By 2009, the Barnwell site may not accept any waste from outside the three-state region.

## Nuclear Energy: Benefits and Problems

The following is a list of benefits and problems associated with nuclear powerplants. A key word or phrase in each item is printed in bold face. Read the list and put a **B** in the blank if it is a **benefit** and a **P** if it is a **problem**.

- |  |   |
|--|---|
| _____ Less need for mining and <b>TRANSPORT</b> of fuel.   | _____ Reactors produce <b>LESS WASTE</b> than fossil fuel plants do.                          |
| _____ No <b>POLLUTANTS</b> from burning fuel.  | _____ Higher <b>COST TO BUILD</b> .   |
| _____ Less reliance on <b>IMPORTED FUEL</b> .  | _____ Large amounts of <b>PLUTONIUM</b> could lead to spread of nuclear weapons.              |
| _____ Could be targets for <b>TERRORISTS</b> .   | _____ Possibility of <b>RADIATION ESCAPING</b> .  |
| _____ The fuel <b>COST</b> of a nuclear power-plant is lower than fuel costs for fossil fuel plants. | _____ <b>RADIOACTIVE WASTE</b> must be handled and disposed of safely for thousands of years. |

Now that you have identified the problem areas, look at the arguments below. Each one concerns a problem area and offers arguments for (PRO) and against (CON) expansion of nuclear energy. Complete the arguments by inserting a **KEY WORD** from above into the blanks below for each problem area. Some words may be used more than once and others may not be used at all.

PRO: The \_\_\_\_\_ is made into a type of glass or ceramic, put into special containers and stored in places like salt beds that have been undisturbed for millions of years.

CON: It takes thousands of years for the \_\_\_\_\_ to lose its radioactive properties. We cannot ensure safe disposal for thousands of years and future societies may be hurt.

PRO: For as long as there have been commercial nuclear powerplants, no one has suffered any ill effects brought on by \_\_\_\_\_.

CON: There's always a chance that an accident or mechanical malfunction could present the danger of \_\_\_\_\_.

PRO: Regulations and safeguards can be strictly enforced to keep the \_\_\_\_\_ out of the hands of terrorists. This radioactive waste is usually sealed in unbreakable capsules right after the fuel processing.

CON: Just 10 pounds of radioactive \_\_\_\_\_ is enough to make an atom bomb.

## Nuclear Energy: Benefits and Problems

The following is a list of benefits and problems associated with nuclear power plants. A key word or phrase in each item is printed in bold face. Read the list and put a (B) in the blank if it is a benefit, a (P) if it is a problem.

- |  |   |
|--|---|
| <u>  <b>B</b>  </u> Less need for mining and <b>TRANSPORT</b> of fuel.   | <u>  <b>B</b>  </u> Reactors produce <b>LESS WASTE</b> than fossil fuel plants do.                          |
| <u>  <b>B</b>  </u> No <b>POLLUTANTS</b> from burning fuel.  | <u>  <b>P</b>  </u> Higher <b>COST TO BUILD</b> .   |
| <u>  <b>B</b>  </u> Less reliance on <b>IMPORTED FUEL</b> .  | <u>  <b>P</b>  </u> Large amounts of <b>PLUTONIUM</b> could lead to spread of nuclear weapons.              |
| <u>  <b>P</b>  </u> Could be targets for <b>TERRORISTS</b> .   | <u>  <b>P</b>  </u> Possibility of <b>RADIATION ESCAPING</b> .  |
| <u>  <b>B</b>  </u> The fuel <b>COST</b> of a nuclear power-plant is lower than fuel costs for fossil fuel plants. | <u>  <b>P</b>  </u> <b>RADIOACTIVE WASTE</b> must be handled and disposed of safely for thousands of years. |

Now that you have identified the problem areas, look at the arguments below. Each one concerns a problem area and offers arguments for (PRO) and against (CON) expansion of nuclear energy. Complete the arguments by inserting a KEY WORD (in capitals above) into the blanks above for each problem area.

PRO: The **RADIOACTIVE WASTE** is made into a type of glass or ceramic, put into special containers, and stored in places like salt beds that have been undisturbed for millions of years.

CON: It takes thousands of years for the **RADIOACTIVE WASTE** to lose its radioactive properties. We cannot ensure safe disposal for thousands of years and future societies may be hurt.

PRO: In more than ????? years of commercial nuclear power plant operation, no one has suffered any ill effects brought on by **RADIATION ESCAPING**.

CON: There's always a chance that an accident or mechanical malfunction could present the danger of **RADIATION ESCAPING**.

PRO: Regulations and safeguards can be strictly enforced to keep the **PLUTONIUM** out of the hands of terrorists. This radioactive waste is usually sealed in unbreakable capsules right after the fuel processing.

CON: Just 10 pounds of radioactive **PLUTONIUM** is enough to make an atom bomb.